

IN THE SPECIFICATION

Please replace the paragraph beginning at page 1, line 7, with the following rewritten paragraph:

The present invention relates to a method for bleaching teeth for removing pigments deposited on teeth (coloration and discoloration of teeth) by an action of a photocatalyst, and a bleaching agent for teeth suitable for carrying out the method for bleaching teeth. More specifically, it relates to a method for bleaching teeth by applying a bleaching agent for teeth having a photocatalytic activity on a surface of teeth, and irradiating the applied part with light to bleach the teeth based on a photocatalytic action thus produced, and a bleaching agent for teeth useful for carrying out the method for bleaching teeth comprising a solution containing ~~nitrogen-deeped~~ nitrogen-doped titanium oxide powder that produces a photocatalytic action upon irradiation with light.

Please replace the paragraph beginning at page 5, line 14, with the following rewritten paragraph:

As a result of earnest investigations made by the inventors for solving the problems associated with the conventional techniques, it has been found that in the case where ~~nitrogen-deeped~~ nitrogen-doped titanium oxide as mentioned below is used, the absorption edge of the light absorption spectrum can be shifted to a long wavelength side in comparison to the conventional case using titanium dioxide, so as to exhibit a photocatalytic activity with light having a longer wavelength, whereby a method for bleaching teeth and a bleaching agent for teeth exhibiting a high catalytic activity with visible light can be obtained, and thus the invention has been completed. Examples of the ~~nitrogen-deeped~~ nitrogen-doped titanium oxide include those obtained in such a manner that titanium dioxide excellent in stability to water and acids is basically used as a photocatalytic substance, and it is subjected to one or

more of these operations, i.e., a part of the oxygen site of titanium dioxide is substituted with a nitrogen atom as proposed in W001/10552 by the inventors, a nitrogen atom is doped among the lattice of titanium dioxide crystals, and a nitrogen atom is doped on the crystalline boundaries of titanium dioxide.

Please replace the paragraph beginning at page 6, line 12, with the following rewritten paragraph:

That is, the present invention relates to a method for bleaching teeth comprising steps of applying a solution containing ~~nitrogen-deeped~~ nitrogen-doped titanium oxide powder on a surface of teeth, and irradiating the applied part with light to bleach the teeth based on a photocatalytic action thus produced, and it also relates to a bleaching agent for teeth comprising a solution containing ~~nitrogen-deeped~~ nitrogen-doped titanium oxide powder that is suitable for carrying out the method for bleaching teeth. It is preferred in the method for bleaching teeth that light thus irradiated is visible light. It is preferred in the bleaching agent for teeth that the ~~nitrogen-deeped~~ nitrogen-doped titanium oxide is a photocatalytic substance having a Ti-O-N structure having a titanium oxide crystalline lattice containing nitrogen and exhibiting a photocatalytic action in a visible light region, and in this case, it is further preferred that the ~~nitrogen-deeped~~ nitrogen-doped titanium oxide contains titanium oxide containing no nitrogen on the outer surface thereof, a surface of the ~~nitrogen-deeped~~ nitrogen-doped titanium oxide comprises a ceramic carried in an island form, needle form or a mesh form, and the surface of the ~~nitrogen-deeped~~ nitrogen-doped titanium oxide carries a charge separation substance. It is also preferred in the bleaching agent for teeth that the bleaching agent contains from 0.01 to 5% by weight of the ~~nitrogen-deeped~~ nitrogen-doped titanium oxide powder, the ~~nitrogen-deeped~~ nitrogen-doped titanium oxide powder has a specific surface area of 10 to 500 m²/g, the solution contains water and/or an alcohol or a polyhydric

alcohol as a solvent, the bleaching agent further contains 0.5 to 20% by weight of a thickener, the bleaching agent further contains 1 to 20% by weight of hydrogen peroxide, and the bleaching agent further contains 2 to 45% by weight of urea peroxide.

Please replace the paragraph beginning at page 7, line 23, with the following rewritten paragraph:

The bleaching agent for teeth according to the present invention has a solution containing ~~nitrogen-deeped~~ nitrogen-doped titanium oxide powder, and preferably a solution containing ~~nitrogen-deeped~~ nitrogen-doped titanium oxide in an amount of 0.01 to 5% by weight based on the total amount of the bleaching agent for teeth. The ~~nitrogen-deeped~~ nitrogen-doped titanium oxide powder is preferably a photocatalytic substance having a Ti-O-N structure having a titanium oxide crystalline lattice containing nitrogen and exhibiting a photocatalytic action in a visible light region as proposed in W001/10552.

Please replace the paragraph beginning at page 8, line 9, with the following rewritten paragraph:

The ~~nitrogen-deeped~~ nitrogen-doped titanium oxide may be nitrogen-doped titanium oxide shown in W001/10552 and can be produced by heat treating titanium oxide or hydrated titanium oxide in an atmosphere containing ammonia gas, an atmosphere containing a nitrogen gas, or a mixed atmosphere of a nitrogen gas and a hydrogen gas. The ~~nitrogen-deeped~~ nitrogen-doped titanium oxide can also be produced by mixing and agitating powder of titanium oxide and urea and then heating the mixture as shown in JP-A-2002-154823.

Please replace the paragraph beginning at page 8, line 19, with the following rewritten paragraph:

The ~~nitrogen-deeped~~ nitrogen-doped titanium oxide used in the present invention may contain titanium oxide containing no nitrogen on the outer surface thereof as shown in W001/10552. According to the configuration, the hydrophilicity of the powder surface is improved, and the bleaching capability in wet conditions can be improved.

Please replace the paragraph beginning at page 9, line 1, with the following rewritten paragraph:

The ~~nitrogen-deeped~~ nitrogen-doped titanium oxide used in the present invention may comprise ceramics carried in an island form, needle form or a mesh form on the surface thereof, as shown in W001/10552. Examples of the ceramics include at least one selected from alumina, silica, zirconia, magnesia, calcia, calcium phosphate, apatite, amorphous titanium oxide and a fluorine resin. The ceramics are liable to absorb stains deposited on teeth and can improve the bleaching capability.

Please replace the paragraph beginning at page 9, line 10, with the following rewritten paragraph:

As the ~~nitrogen-deeped~~ nitrogen-doped titanium oxide used in the present invention, such kinds of titanium dioxide may be used that are formed in such a manner that titanium of the ~~nitrogen-deeped~~ nitrogen-doped titanium oxide is substituted with at least one kind selected from vanadium, chromium, manganese, iron, cobalt, nickel, copper, zinc, ruthenium, rhodium, rhenium, osmium, palladium, platinum, iridium, niobium and molybdenum, or at least one of these elements is doped among the lattice of titanium dioxide crystals or on the crystalline boundaries of polycrystalline aggregates of titanium dioxide, as shown in JP-A-2001-205104. The absorption edge of the light absorption spectrum of these kinds of ~~nitrogen-deeped~~ nitrogen-doped titanium oxide can be shifted to a long wavelength side in

comparison to the conventional case using titanium dioxide, so as to exhibit a photocatalytic activity with light having a longer wavelength.

Please replace the paragraph beginning at page 10, line 3, with the following rewritten paragraph:

The nitrogen-deeped nitrogen-doped titanium oxide used in the present invention may carry a charge separation substance on the surface thereof as shown in JP-A-2001-205103. Examples of the charge separation substance include at least one selected from Pt, Pd, Ni, RuO_x, NiO_x, SnO_x, Al_xO_y and ZnO_x. The charge separation substance scavenges electrons or positive holes, and thus recombination of electrons and positive holes is effectively prevented. Therefore, the photocatalytic reaction can be carried out in a more effective manner to improve the bleaching capability.

Please replace the paragraph beginning at page 10, line 14, with the following rewritten paragraph:

In the case where the mixing amount of the nitrogen-deeped nitrogen-doped titanium oxide is less than 0.01% by weight, there is such a tendency that the effect as a photocatalyst is difficult to be obtained, and in the case where it is mixed in an amount exceeding 5% by weight, there is such a possibility that the bleaching agent for teeth is deteriorated in transparency, and thus the bleaching capability is reduced due to reduction in light transmittance. The mixing amount of the nitrogen-deeped nitrogen-doped titanium oxide is more preferably 0.01 to 2% by weight. The specific surface area of the nitrogen-deeped nitrogen-doped titanium oxide powder is preferably 10 to 500 m²/g, and nitrogen-deeped nitrogen-doped titanium oxide powder having a specific surface area less than 10 m²/g has such a possibility of decreasing the catalytic activity, whereas there is a strong tendency that

production, procurement and use of ~~nitrogen-deeped~~ nitrogen-doped titanium oxide powder having a specific surface area exceeding $500 \text{ m}^2/\text{g}$ are difficult.

Please replace the paragraph beginning at page 11, line 8, with the following rewritten paragraph:

In the bleaching agent for teeth of the present invention, in order that the ~~nitrogen-deeped~~ nitrogen-doped titanium oxide powder is effectively made in contact with teeth, it is necessary that the bleaching agent for teeth is formed into a solution (including a paste) by using a solvent. The solvent for the solution is preferably water and/or an alcohol. Among these, water is the most preferred from the standpoint of reactivity of the ~~nitrogen-deeped~~ nitrogen-doped titanium oxide, and ethanol and a polyhydric alcohol are the most preferred from the standpoint of the application operation of the bleaching agent for teeth to teeth. In the polyhydric alcohol, glycerin, ethylene glycol, diethylene glycol, polyethylene glycol, propylene glycol, polypropylene glycol, sorbitol, mannitol and mixtures thereof are preferred since they are excellent in safety and good in affinity to teeth.

Please replace the paragraph beginning at page 12, line 1, with the following rewritten paragraph:

It is preferred that the bleaching agent of the present invention further contains a thickener in an amount of 0.5 to 20% by weight based on the total amount of the bleaching agent for teeth in order that the ~~nitrogen-deeped~~ nitrogen-doped titanium oxide is easily coated on teeth and is effectively stayed on the tooth surface. The mixing amount of the thickener of less than 0.5% by weight is difficult to obtain effect of mixing it, and mixing in an amount exceeding 20% by weight causes a possibility of deterioration in operability on application to teeth due to a too high viscosity of the solution. The thickener used in the

present invention may be those thickeners that have been used in the field of dentistry without particular limitation, and examples thereof include a synthetic additive, such as cellulose sodium glycolate, sodium alginate, alginic acid propylene glycol ester, sodium carboxymethyl cellulose, calcium carboxymethyl cellulose, starch sodium glycolate, starch sodium phosphate ester, sodium polyacrylate, methyl cellulose, hydroxypropyl cellulose and polyvinyl pyrrolidone, a natural thickener, such as guar gum, tara gum, tamarind seed gum, gum arabic, tragant gum, karaya gum, alginic acid, carrageenan, xanthan gum, gellan gum, curdlan, chitin, thitosan, and chitosamine, and an inorganic thickener, such as calcium carbonate, calcium silicate, magnesium silicate, magnesium sodium silicate, silica powder, amorphous hydrous silicic acid and fumed silica. It has been confirmed by experimentation that the suitable viscosity obtained with the thickener is preferably in a range from 0.3 to 10 Pa. s (at 25°C). The mixing amount of the thickener for obtaining the viscosity in that range varies within the foregoing range depending on the species of the thickener. The mixing amount may be only about 0.5 to 8% for cellulose sodium glycolate or the like having a large thickening effect, whereas it is necessarily 15% or more for methyl cellulose or the like, and the suitable mixing amount is determined individually for the respective thickeners.

Please replace the paragraph beginning at page 13, line 16, with the following rewritten paragraph:

The bleaching agent for teeth according to the present invention may further contain hydrogen peroxide in an amount of 1 to 20% by weight based on the total amount of the bleaching agent for teeth in order to obtain bleaching effect by synergistic effect of the ~~nitrogen-deeped~~ nitrogen-doped titanium oxide and hydrogen peroxide in a low concentration. In the case where the mixing amount of hydrogen peroxide is less than 1% by weight, the effect of hydrogen peroxide is difficult to be obtained, and in the case where it is

added in an amount exceeding 20% by weight, there is possible adverse affect to a living body due to corrosive nature of hydrogen peroxide. Upon irradiating the ~~nitrogen-deeped~~ nitrogen-doped titanium oxide powder with light, electrons and positive holes are generated, and they are reacted with hydrogen peroxide to form active oxygen. Active oxygen has larger oxidation power than ozone and can oxidatively decompose almost all organic substances to carbon dioxide gas. Even in the case of n-type semiconductor titanium oxide powder having a relatively large band gap, active oxygen having strong oxidation power is easily produced by irradiation with light upon using, for example, as a solution with a 3% hydrogen peroxide aqueous solution, and thus such factors as charge separation, mobility of electrons and positive holes, and reactivity with protons and hydroxyl groups, are increased in comparison to the sole use thereof, whereby the synergistic effect can be exerted correlative with the oxidation action of the hydrogen peroxide aqueous solution itself.

Please replace the paragraph beginning at page 15, line 7, with the following rewritten paragraph:

The bleaching agent for teeth according to the present invention is a solution containing ~~nitrogen-deeped~~ nitrogen-doped titanium oxide, and for example, can be used in the form of solution as it is. In the case where hydrogen peroxide and/or urea peroxide is mixed, the mode of provision of them is not particularly limited, and for example, it is possible that the additional components are separately prepared and accompanied to the solution, and they are then mixed at a time of use. In addition, the bleaching agent for teeth according to the present invention may contain ordinary additives, such as a sweetener, a perfume and an antiseptic.

Please replace the paragraph beginning at page 15, line 19, with the following rewritten paragraph:

In the method for bleaching teeth according to the present invention, the solution containing ~~nitrogen-deeped~~ nitrogen-doped titanium oxide powder is applied to the surface of teeth. As one of the simplest methods for applying the solution on the surface of teeth, the solution containing ~~nitrogen-deeped~~ nitrogen-doped titanium oxide powder having a photocatalytic action as the bleaching agent for teeth is directly coated on teeth by using a brush or the like. Other examples thereof include such a method that cloth, paper, glass cloth, ceramic paper, organic gel or inorganic gel is impregnated with the bleaching agent for teeth and attached to the surface of teeth, followed by irradiating with light. Moreover, any appropriate methods can also be employed, such as a method, in which the bleaching agent for teeth is retained by a suitable carrier, such as a carrier in the form of a mouse guard, and it is outfit on teeth or a tooth raw to attach the solution to teeth.

Please replace the paragraph beginning at page 17, line 4, with the following rewritten paragraph:

The method for bleaching teeth according to the present invention can be carried out by repeating several times such an operation that the bleaching agent for teeth, which is the solution containing ~~nitrogen-deeped~~ nitrogen-doped titanium oxide having a photocatalytic action, is applied to the surface of teeth, which is then irradiated with light. The number of repetitions of the application and irradiation operations may be appropriately adjusted depending on the extent of discoloration of the teeth. The application and light irradiation operations may be generally carried out by applying a fresh solution on the teeth with an interval of about 15 to 20 minutes, and the interval and the frequency thereof may be appropriately determined depending on the conditions of the teeth and the formulation of the

bleaching agent for teeth. The method for bleaching teeth according to the present invention is effective for bleaching both demyelinated teeth and myelinated teeth and exerts remarkable effect on bleaching the teeth in a simple and safe manner.

Please replace the paragraph beginning at page 18, line 6, with the following rewritten paragraph:

As shown in Tables 1 to 13, ~~nitrogen-deeped~~ nitrogen-doped titanium oxide powder was mixed and dispersed in one or a plurality of water, ethanol, glycerin, polyethylene glycol (weight average molecular weight: 200) and sorbitol as a solvent, and then a small amount of a thickener (magnesium sodium silicate and silica fine powder (Aerosil R972, a trade name, produced by Nippon Aerosil Co., Ltd.)) was added thereto depending on necessity, so as to produce bleaching agents for teeth, which were then sealed in light shielding containers.

Please replace the paragraph beginning at page 18, line 17, with the following rewritten paragraph:

The following kinds of ~~nitrogen-deeped~~ nitrogen-doped titanium oxide powder were used.

Please replace the paragraph beginning at page 19, line 24, with the following rewritten paragraph:

In the case of a combination of such components that a metallic component (platinum in the examples) in the ~~nitrogen-deeped~~ nitrogen-doped titanium oxide and hydrogen peroxide were to start to react with each other immediately after mixing, the components were produced as separated to two or more portions, and the two or more portions of the bleaching agent for teeth were mixed immediately before application to teeth (Examples 19,

25, 26, 45, 51 and 52). In the case where the components were a combination of urea peroxide and water to be mixed, they were produced as separated to two or more portions since urea peroxide were to start to decompose by water immediately after mixing urea peroxide with water, and the two or more portions of the bleaching agent for teeth were mixed immediately before application to teeth (Examples 26 and 52). In the bleaching agent for teeth constituted of two or more portions in the examples, the same amounts (by weight) of the portions were mixed. The case using titanium dioxide powder (ST-01, a trade name, produced by Ishihara Sangyo Kaisha, Ltd.) as conventional titanium dioxide powder was designated as Comparative Example 1.

Please replace the paragraph beginning at page 32, line 9, with the following rewritten paragraph:

As described in the foregoing in detail, the method for bleaching teeth and the bleaching agent for teeth according to the present invention uses ~~nitrogen-deeped~~ nitrogen-doped titanium oxide, whereby the absorption edge of the light absorption spectrum can be shifted to a long wavelength side in comparison to the conventional case using titanium dioxide, so as to exhibit a photocatalytic activity with light having a longer wavelength. As a result, such a bleaching agent for teeth excellent in performance is provided that exhibits high bleaching effect even by using a dental visible light irradiator, which is generally used in dentistry, and such a method for bleaching teeth using the bleaching agent for teeth is also provided that can effectively bleach teeth with enjoying the effects of the bleaching agent. The ~~nitrogen-deeped~~ nitrogen-doped titanium oxide can be obtained in such a manner that titanium dioxide excellent in stability to water and acids is basically used as a photocatalytic substance, and it is subjected to one or more of these operations, i.e., a part of the oxygen site of titanium dioxide is substituted with a nitrogen atom, a nitrogen atom is doped among the

lattice of titanium dioxide crystals, and a nitrogen atom is doped on the crystalline boundaries of titanium dioxide. Accordingly, the present invention greatly contributes to the field of bleach of teeth.

Please amend the Abstract at page 37 as follows:

ABSTRACT OF THE DISCLOSURE

A method for bleaching teeth ~~comprises steps of~~ comprising applying a solution containing ~~nitrogen-deeped~~ nitrogen-doped titanium oxide powder on a surface of the teeth, and irradiating the applied part with light to bleach the teeth ~~based on a~~ by photocatalytic action ~~thus produced~~, and a bleaching agent for teeth teeth, ~~suitable for carrying out the~~ ~~method comprises a~~ The bleaching agent comprises a solution containing ~~nitrogen-deeped~~ nitrogen-doped titanium oxide powder, water and/or alcohol, thickener, hydrogen peroxide, and urea peroxide. ~~The nitrogen-doped in which the nitrogen-deeped titanium oxide is preferably a photocatalytic substance having a Ti-O-N structure, having a titanium oxide crystalline lattice containing nitrogen and exhibiting a~~ exhibits photocatalytic action in a the visible light region, the bleaching agent region. The bleaching agent preferably contains preferably 0.01 to 5% by weight of the nitrogen-deeped titanium oxide powder, the nitrogen-deeped titanium oxide powder has having a specific surface area of from 10 to 500 m²/g, the solution contains water and/or an alcohol as a solvent, and the bleaching agent further contains contains preferably contains 0.5 to 20% by weight of a thickener, 1 to 20% by weight of hydrogen peroxide, and 2 to 45% by weight of urea peroxide.

IN THE CLAIMS

Please amend the claims as follows:

Claim 1 (Currently Amended): A method for bleaching teeth comprising ~~steps of~~ applying a solution containing ~~nitrogen-deeped~~ nitrogen-doped titanium oxide powder on a surface of teeth, and irradiating the applied part with light to bleach the teeth based on a photocatalytic action thus produced.

Claim 2 (Currently Amended): A The method for bleaching teeth as claimed in claim 1, wherein visible light is irradiated as the light.

Claim 3 (Currently Amended): A bleaching agent for teeth comprising a solution containing ~~nitrogen-deeped~~ nitrogen-doped titanium oxide powder, which is attached to a surface of teeth and irradiated with light to bleach the teeth based on a photocatalytic action thus produced.

Claim 4 (Currently Amended): A The bleaching agent for teeth as claimed in claim 3, wherein the ~~nitrogen-deeped~~ nitrogen-doped titanium oxide is a photocatalytic substance having a Ti-O-N structure having a titanium oxide crystalline lattice containing nitrogen and exhibiting a photocatalytic action in a visible light region.

Claim 5 (Currently Amended): A The bleaching agent for teeth as claimed in claim 4, wherein the ~~nitrogen-deeped~~ nitrogen-doped titanium oxide contains titanium oxide containing no nitrogen on the outer surface thereof.

Claim 6 (Currently Amended): ~~A~~ The bleaching agent for teeth as claimed in claim 4, wherein a surface of the ~~nitrogen-deeped~~ nitrogen-doped titanium oxide comprises a ceramic carried in an island form, needle form or a mesh form.

Claim 7 (Currently Amended): ~~A~~ The bleaching agent for teeth as claimed in claim 4, wherein a surface of the ~~nitrogen-deeped~~ nitrogen-doped titanium oxide carries a charge separation substance.

Claim 8 (Currently Amended): ~~A~~ The bleaching agent for teeth as claimed in ~~any one of claims 3 to 7~~ claim 3, wherein the bleaching agent for teeth contains 0 . 01 to 5% by weight of the ~~nitrogen-deeped~~ nitrogen-doped titanium oxide powder.

Claim 9 (Currently Amended): ~~A~~ The bleaching agent for teeth as claimed in ~~any one of claims 3 to 8~~ claim 3, wherein the ~~nitrogen-deeped~~ nitrogen-doped titanium oxide powder has a specific surface area of 10 to 500 m²/g .

Claim 10 (Currently Amended): ~~A~~ The bleaching agent for teeth as claimed in ~~any one of claims 3 to 9~~ claim 3, wherein the solution contains water and/or an alcohol as a solvent.

Claim 11 (Currently Amended): ~~A~~ The bleaching agent for teeth as claimed in claim 10, wherein the alcohol is a polyhydric alcohol.

Claim 12 (Currently Amended): A The bleaching agent for teeth as claimed in any ~~one of claims 3 to 11~~ claim 3, wherein the bleaching agent for teeth further comprises 0.5 to 20% by weight of a thickener.

Claim 13 (Currently Amended): A The bleaching agent for teeth as claimed in any ~~one of claims 3 to 12~~ claim 3, wherein the bleaching agent for teeth further comprises 1 to 20% by weight of hydrogen peroxide.

Claim 14 (Currently Amended): A The bleaching agent for teeth as claimed in any ~~one of claims 3 to 13~~ claim 3, wherein the bleaching agent for teeth further comprises 2 to 45% by weight of urea peroxide.

REMARKS

The specification has been amended to correct typographical errors.

The Abstract is amended to contain less than 150 words.

Claims 1-14 are active.

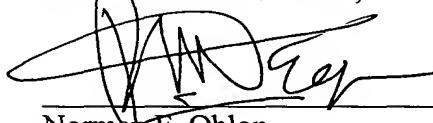
Claims 1-14 have been amended to delete multiple dependencies and correct typographical errors.

No new matter is believed to have been added.

Applicants respectfully submit that the present application is in condition for examination on the merits and early consideration is kindly requested.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, P.C.



Norman F. Oblon
Attorney of Record
Registration No. 24,618

Customer Number
22850

Tel: (703) 413-3000
Fax: (703) 413-2220
(OSMMN 08/03)
NFO/RMJ/cja

Rohitha M. Jayasuriya
Registration No. 50,385